INDOOR AIR QUALITY ASSESSMENT

M. Norcross Stratton Elementary School
180 Mountain Avenue
Arlington, MA 02474

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of the Arlington Board of Health (BOH) and Arlington Public Schools (APS), the Massachusetts Department of Public Health's (MDPH), Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality concerns at the Stratton Elementary School (SES), 180 Mountain Avenue, Arlington, Massachusetts. The request was prompted by concerns about general indoor air quality and mold.

On December 14, 2004, a visit to conduct an assessment of the SES was made by Michael Feeney, Director of CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, and Sharon Lee, an Environmental Analyst in the ER/IAQ Program. The SES is a two-story, red brick building constructed in the 1960s. The school is built at the top of a hill and resides on a concrete slab. The first floor consists of general classrooms, a gymnasium (gym B) and office space. The second floor contains general classrooms, special education rooms, computer room, cafeteria, a gymnasium, library and offices. Windows throughout the building are openable.

As mentioned, general indoor air quality and mold concerns, primarily on the first floor of the building, prompted the assessment. Although the school is constructed at the top of a hill, portions of the first floor are located downhill. Since the first floor abuts a hillside, the school has experienced moisture problems along walls in direct contact with soil. Prior to the 2004-2005 school year, the APS replaced damaged/buckling floor tiles on the first floor. Damaged materials were removed, and first floor rooms were cleaned and disinfected prior to occupancy.

Despite remediation efforts, concerns were reported by first floor occupants. In response, the Arlington BOH conducted an assessment of first floor rooms on September 14, 2004. According to the memo addressed to Kay Donovan, Superintendent of Schools, the BOH did not find evidence of mold growth or moisture present at the time of their assessment (Connolly, 2004). In response to air quality concerns, the BOH noted that univents were blocked by items, thereby preventing proper air circulation (Connolly, 2004).

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were conducted with the TSI, Q-TRAK™ IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). MDPH staff also performed a visual inspection of building materials for water damage and/or microbial growth.

Results

This school houses approximately 500 kindergarten through fifth grade students, as well as approximately 75 staff members. Tests were taken during normal operations at the school. Results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were elevated above 800 parts per million (ppm) in 26 of 37 areas surveyed, indicating inadequate air exchange in the majority of areas surveyed. Fresh air in classrooms is supplied by unit ventilator (univent) systems (Picture

1). A univent draws air from outdoors through a fresh air intake located on the exterior wall of the building (Picture 2) and returns air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and/or cooled and provided to classrooms through a diffuser located on the top of the unit. Obstructions to airflow, such as furniture located in front of and/or materials stored on univents, were observed in many areas (Pictures 1 and 3). Moreover, many univents were not operating at the time of the assessment. In order for univents to provide fresh air as designed, intakes and returns must remain free of obstructions and importantly, these units must remain activated and allowed to operate while rooms are occupied.

Mechanical exhaust ventilation in classrooms is provided by wall-mounted exhaust vents (Picture 4) ducted to rooftop exhaust fans (Picture 5). APS staff indicated one exhaust fan motor was not operating at the time of the assessment. As a result, a number of exhaust vents were off at the time of the assessment. It is important to note that the location of some exhaust vents can limit exhaust efficiency. In some classrooms, exhaust vents are located behind hallway doors (Picture 6). When classroom doors are open, exhaust vents are blocked. In addition, other blockages to exhaust (i.e., furniture or items placed in front) were noted (Picture 7). The effectiveness of exhaust vents to remove common environmental pollutants from classrooms becomes reduced when the vent is blocked. As with univents, exhaust vents must remain free of obstructions in order to operate as designed.

Large common areas at the SES (e.g., cafeteria, library) have mechanical ventilation provided by roof top air-handling units (AHUs). Fresh heated air is supplied through ceiling mounted air diffusers and ducted back to the AHUs via return vents.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room, while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing was unknown at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, see Appendix A.

Temperature measurements ranged from 60^o F to 74^o F, which in some areas was below the MDPH recommended comfort range. Please note, lower classroom temperatures of 60^o F to 62^o F were measured in the kindergarten classrooms, where students were preparing to leave through an open exterior door in the hallway. As a result of the open exterior door, classroom temperatures were significantly lower. The MDPH recommends that indoor air temperatures be maintained in a range of 70^o F to 78^o F in order to provide for the comfort of building occupants. A number of occupants had temperature control concerns. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It is also difficult to control temperature without the mechanical ventilation system functioning as designed (e.g., univents/exhausts not operating/obstructed).

The relative humidity measured in the building ranged from 14 to 41 percent, which was below the MDPH recommended comfort range in the majority of areas assessed. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

As previously discussed, concerns of potential mold growth in the lower level of the SES prompted the assessment. MDPH staff inspected lower level classrooms (primarily building materials) for water damage. In order for building materials to support mold growth, a source of moisture is necessary. Identification and elimination of water moistening building materials is necessary to control mold growth. Building materials with increased moisture content over normal concentrations may indicate the possible presence of mold growth. Identification of the location of materials with increased moisture levels can also provide clues concerning the source of water supporting mold growth.

In an effort to ascertain moisture content of building materials in lower level areas, moisture readings were taken in materials that would most likely be impacted by moisture. Building materials tested included ceiling tiles, wooden wallboards, carpeting and wooden shelving. Moisture content was measured with a Delmhorst moisture meter. The Delmhorst probe is equipped with three lights that function as visual aids that indicate moisture level. Readings that activate the green light indicate a sufficiently dry or low moisture level, those that activate the yellow light indicate borderline conditions and those that activate the red light indicate elevated moisture content. No elevated moisture readings were measured during the assessment. In addition, a thorough visual examination of the floors and walls was conducted. Floor tiles had been replaced over the summer, and there were no signs of damage to the floor. Classroom walls are constructed of cement blocks, which are generally not conducive to mold colonization.

No visible mold growth or associated odors were observed/detected during the assessment, however some potential sources for mold growth were observed at the SES. Spaces between the sink countertop and backsplash were seen in several areas (Picture 8). Improper drainage or sink overflow can lead to water penetration into the countertop, cabinet interior and areas behind cabinets. If these materials become wet repeatedly they can provide a medium for mold growth. The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur.

Plants were noted in several areas (Picture 9). Plants, soil and drip pans can serve as sources of mold growth, and thus should be properly maintained. Plants should have drip pans to prevent wetting and subsequent mold colonization of window frames. Plants should also be located away from univents and ventilation sources to prevent aerosolization of dirt, pollen or mold.

During an inspection of the building exterior, MDPH staff observed damage to the foundation (Pictures 10 and 11). Breaches, cracks and holes in the foundation can serve as points for water entry into the building. Continued freezing and thawing of water during cooler months will serve only to further damage the foundation. In addition, breaches can serve as points of entry or shelter for pests.

Lastly, pooling water was observed on the roof as a result of poor drainage (Picture 12). In one case, a roof drain was observed to be clogged with leaves and other debris (Picture 13). Roof drains should be cleared of debris to prevent water pooling on the roof. Over time, pooling water can seep into the building, causing damage to ceiling tiles and other building materials. Freezing and thawing of pooled water can eventually degrade the integrity of the rubber membrane roof, causing cracks to form. These breaches can allow water to penetrate the building.

Other Concerns

Indoor air quality can be adversely impacted by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion products include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide pollution and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from 6 criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS established by the US EPA, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect or ND (Table 1). Carbon monoxide levels measured in the school were also ND.

As previously mentioned, the US EPA also established NAAQS for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). This standard was adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particulate levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 18 μg/m^3 (Table 1). PM2.5 levels measured indoors ranged from 2 to 14 μg/m^3, which were below background and the NAAQS PM2.5 level of 65 μg/m^3. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be impacted by the presence of materials containing volatile organic compounds (VOCs). VOCs are substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC measurements throughout the building were also ND.

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC-containing products. While no measurable TVOC levels were detected in the indoor environment, VOC-containing materials were noted. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cleaning products were found on countertops and beneath sinks in a number of classrooms. In some cases, cleaning products were placed in cabinets with childproof locks (Picture 14). Consideration should be given to adopting this practice throughout the school as a measure to prevent child access to cleaning agents. Cleaning products contain VOCs and other chemicals, which can be irritating to the eyes, nose and throat and should be stored properly and kept out of reach of students.

Photocopiers and lamination machines were located in several areas. During use, lamination machines can produce irritating odors. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). Occupants should ensure local exhaust ventilation in these areas is operating to help reduce excess heat and odors.

A strong fragrance was detected in a number of classrooms. The source of these odors was plug-in air fresheners (Picture 15). Air fresheners contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Furthermore, air fresheners do not remove materials causing odors, but rather mask odors that may be present in the area.

Several other conditions that can affect indoor air quality were noted during the assessment. In several classrooms, items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up.

A number of exhaust/return vents, univent supply vents and personal fans were observed to have accumulated dust. If exhaust vents are not functioning, backdrafting can occur, which can re-aerosolize accumulated dust particles. Re-activated univents and fans can also aerosolize dust accumulated on vents/fan blades.

Several areas contained window-mounted air conditioners (ACs). These type of ACs are normally equipped with filters. MDPH staff observed dust occluded on AC filters (Picture 16), which should be cleaned or changed as per manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter. Univents are also normally equipped with filters that strain particulates from airflow. The univent filters at the SES provide minimal filtration of respirable dusts. In addition, some univents did not have appropriately sized filters, which allows for air to by-pass the filter (Picture 17). In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) to meet its standard for a dust spot efficiency of a minimum of 40 percent would be sufficient to reduce airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). Note that increased filtration can reduce airflow as a result of increased resistance, a condition known as pressure drop. Prior to any increase of filtration, univents should be evaluated by a ventilation engineer to ascertain whether units can maintain function with more efficient filters.

Large throw pillows and upholstered furniture (i.e., couches) were noted in a few classrooms. These upholstered items are covered with fabric that comes in contact with human skin. This type of contact can leave oils, perspiration, hair and skin cells. Dust mites feed upon human skin cells and excrete waste products that contain allergens. Furthermore, increased relative humidity levels above 60 percent can also perpetuate dust mite proliferation (US EPA, 1992). In order to remove dust mites and other pollutants, frequent vacuuming of upholstered furniture is recommended (Berry, 1994). It is also recommended that if upholstered furniture is present in schools, it should be professionally cleaned on an annual basis or every six months if dusty conditions exist (IICR, 2000).

Rodent droppings were noted in the air-handling cabinet of a univent (Picture 18). Pest attractants were identified within the building. Food-based projects and re-use of food containers were observed. Proper food storage is an integral component in maintaining indoor air quality. Food should be properly stored and clearly labeled. Reuse of food containers is not recommended since food residue adhering to the surface may serve to attract pests.

Rodent infestation can result in indoor air quality related symptoms due to materials in rodent wastes. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms (e.g., running nose or skin rashes) in sensitive individuals. Since particulate materials can be drawn into an air stream, univents with filters that provide minimal respirable dust filtration can serve to distribute these materials. It is important that proper filters be installed in univents to reduce this potential problem.

A three-step approach is necessary to eliminate rodent infestation:

- removal of the rodents;
- cleaning of waste products from the interior of the building; and
- reduction/elimination of pathways/food sources that are attracting rodents.

To eliminate exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior for several months after rodents are eliminated (Burge, 1995). Once the infestation is eliminated, a combination of cleaning, increased ventilation and filtration should serve to reduce allergens associated with rodents.

Breaches were also observed around pipes in univent air-handling cabinets (Picture 19). Spaces of this nature can result in the univent drawing air, odors and debris from the wall cavity or crawlspace. Materials drawn from the crawlspace or wall cavity may bypass the univent filter, providing a means for distributing these materials from an unoccupied to an occupied area.

Pets were noted in a number of classrooms. Cages are lined with wood shavings and some had accumulated wastes. Porous materials (i.e., wood shavings) can absorb animal wastes and be a reservoir for mold and bacterial growth. Animal dander, fur and wastes can all be sources of respiratory irritants. Animal cages should be cleaned regularly to avoid the aerosolization of allergenic materials and/or odors.

Signs of bird roosting and nesting materials were observed in a school bell and exhaust vent, near openable windows and univent fresh air intakes (Picture 20). MDPH staff recommended that the nest be removed to prevent entrainment of bird wastes. Birds can be a source of disease, and bird wastes and feathers can contain mold and bacteria. No obvious signs of bird roosting *inside* the building were noted by MDPH staff nor were such signs reported by occupants.

In an effort to reduce noise from sliding chairs, tennis balls had been sliced open and placed on chair legs (Picture 21). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off-gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix B (NIOSH, 1998). Consider using alternative "glides" on chair legs (Picture 22).

Conclusions/Recommendations

In view of the findings at the time of the assessment, the following recommendations are made:

1. Continue to work with concerned individuals to identify and address IAQ/mold concerns. Should mold issues recur, remove mold-contaminated materials in a manner consistent with recommendations found in "Mold Remediation in Schools and Commercial Buildings" published by the US EPA (2001). Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
2. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers.
3. Remove all blockages from univents and exhaust vents.
4. Operate both supply and exhaust ventilation continuously during periods of school occupancy.
5. Consider having ventilation systems re-balanced/calibrated every five years by an HVAC engineering firm.

6. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
7. Seal breaches between sink countertops and backsplashes with an appropriate sealant to prevent water damage and potential mold growth.
8. Move plants away from univents in classrooms. Ensure all plants are equipped with drip pans. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.
9. Repair damage to building foundation. Consider contacting a building envelope specialist for an evaluation of the building exterior.
10. Maintain roof drains to ensure proper drainage.
11. Store cleaning products properly and out of reach of students. Consider storing cleaning products in cabinets with childproof locks.
12. Refrain from using strongly scented items, such as air deodorizers.
13. Clean univent air diffusers, fan blades and exhaust vents periodically of accumulated dust.
14. Ensure univent filters are flush to casing. Consider increasing the dust-spot efficiency of filters. Prior to any increase of filtration, each piece of air handling equipment should be evaluated by a ventilation engineer as to whether it can maintain function with more efficient filters.

15. Clean filters for window-mounted air conditions as per manufacturer's recommendation.
16. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
17. Remove bird's nests from exhaust vent. Clean and disinfect with an appropriate anti-microbial. Consider installing wire mesh to prevent roosting.
18. Seal spaces around pipes in univent cabinets to prevent the entrainment of odors and particulates into the ventilation system.
19. Clean pet cages regularly to prevent mold growth and associated odors (NIOSH, 1998a).
20. Clean pillows and upholstered furniture on the schedule recommended in this report. If not possible/practical, remove upholstered furniture from classrooms.
21. Store and label food appropriately. Refrain from re-using food containers. Use the principles of integrated pest management (IPM) to rid the building of pest. A copy of the IPM Guide can be obtained at the following Internet address: http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf
22. Ensure local exhaust ventilation in areas with photocopiers/lamination machines is activated or relocate equipment to a well-ventilated area.
23. Consider discontinuing use of tennis balls on chair legs and replacing tennis balls with alternative glides.
24. Consider adopting the US EPA (2000b) document, "Tools for Schools", to maintain a good indoor air quality environment in the building. This document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

25. Refer to resource manuals and other related indoor air quality documents for additional building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH's website: http://www.state.ma.us/dph/MDPH/iaq/iaqhome.htm.

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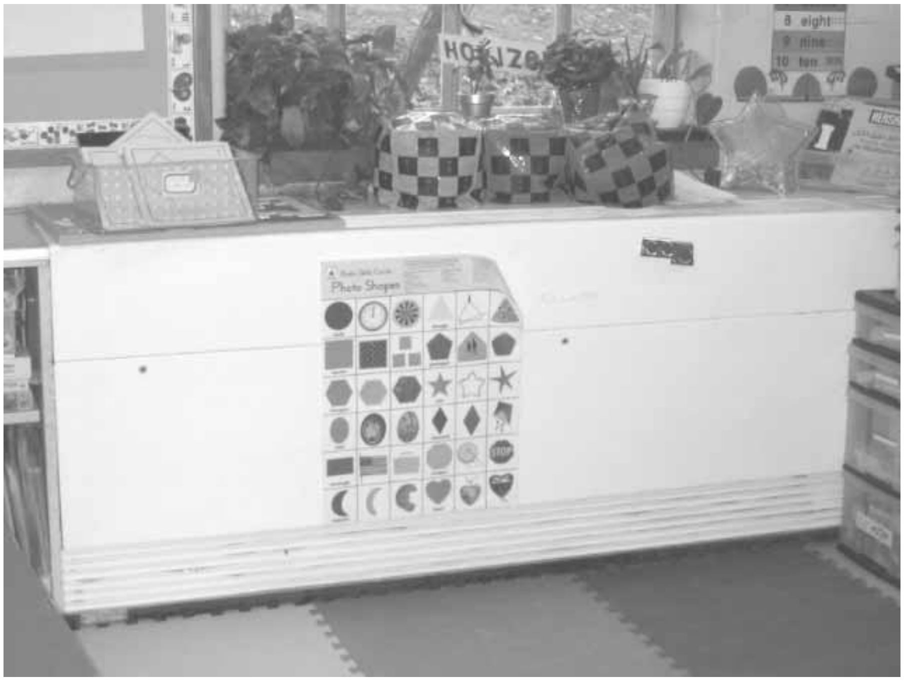
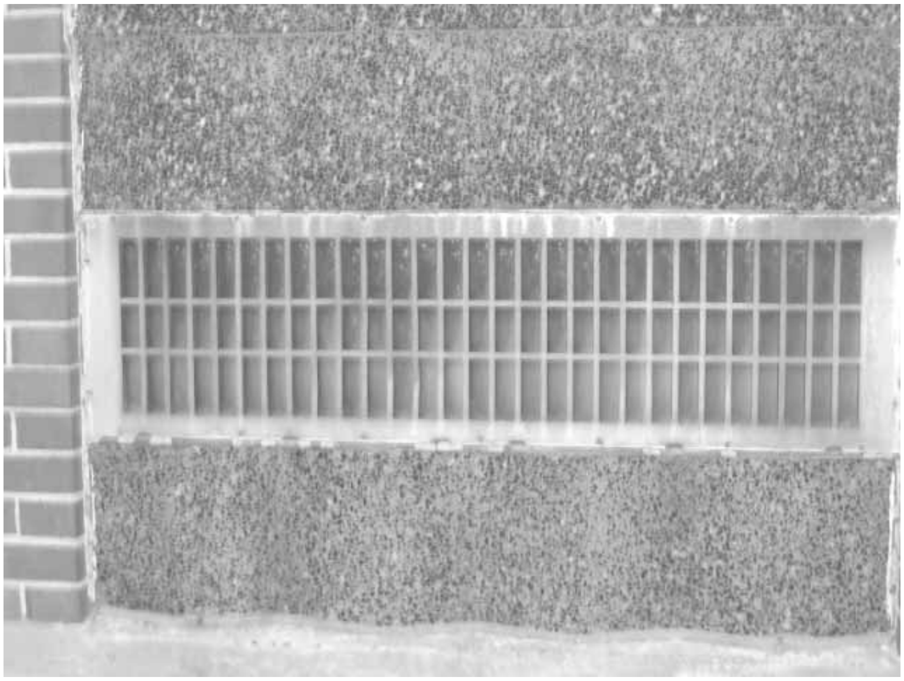
Picture 1



Classroom univent, note items on top of unit

Picture 2



Univent fresh air intake

Picture 3

Furniture placed in front of univent

Picture 4

Classroom wall exhaust vent

Picture 5

Rooftop exhaust fan

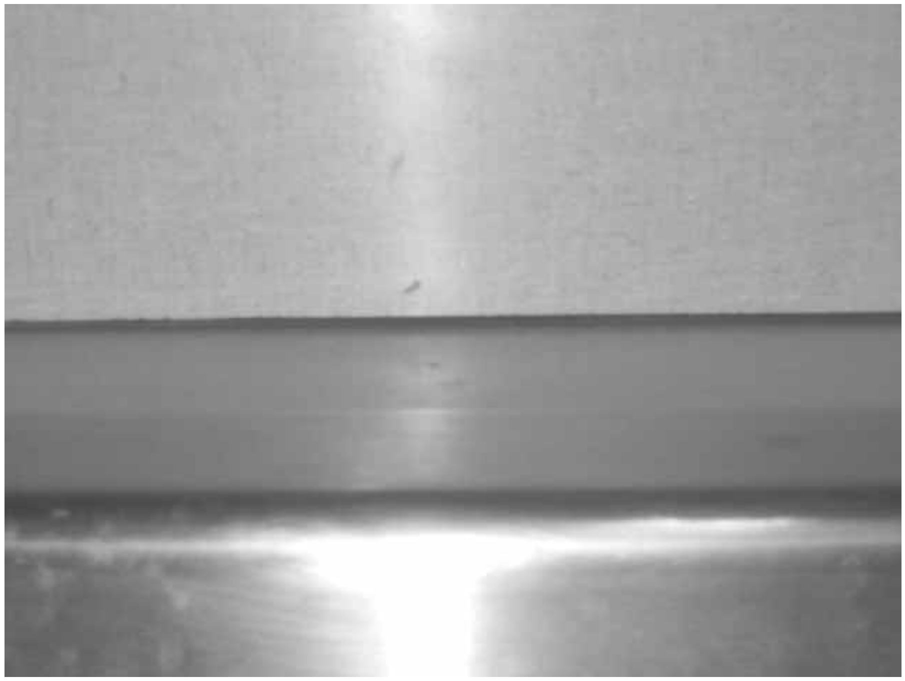
Picture 6

Exhaust vent located behind door

Picture 7

Furniture placed in front of wall exhaust

Picture 8



Breach between sink countertop and backsplash

Picture 9

Plants in classroom

Picture 10

Damage to foundation

Picture 11

Crack in foundation

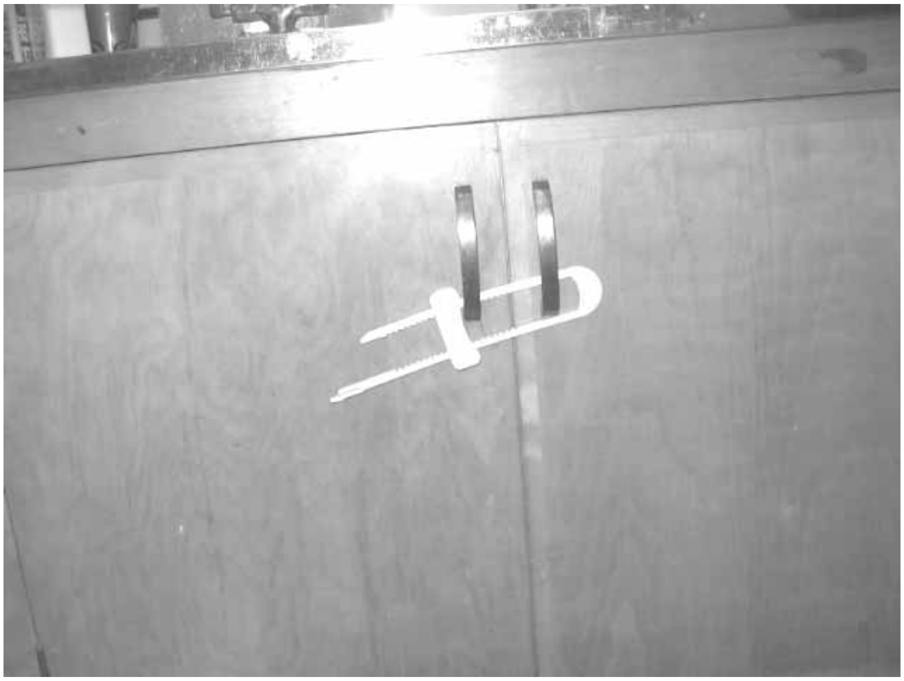
Picture 12

Water pooling on rooftop

Picture 13

Clogged roof drain

Picture 14



Use of childproof locks on cabinets

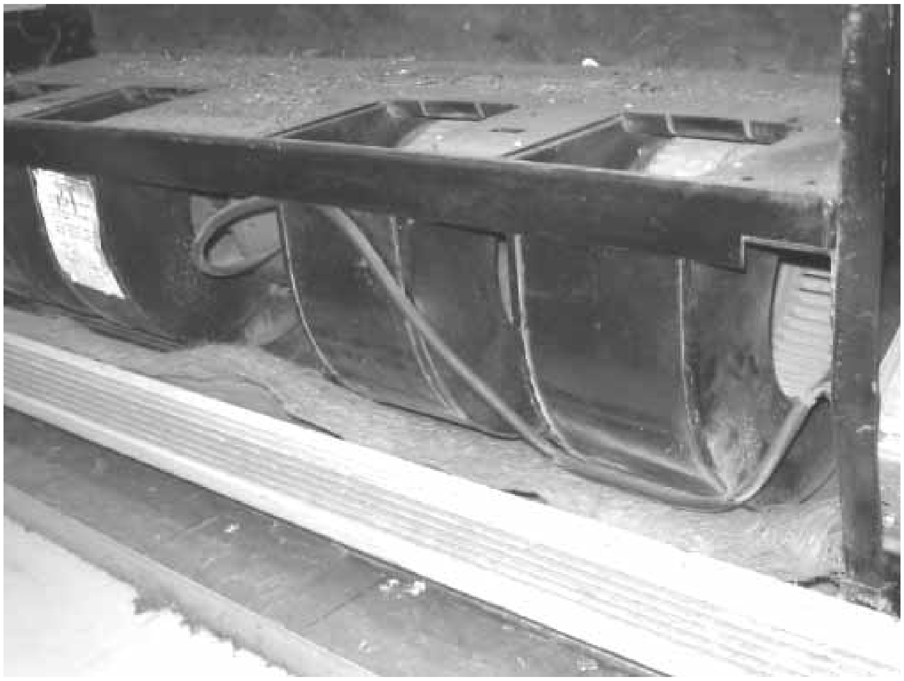
Picture 15

Plug-in air deodorizer

Picture 16

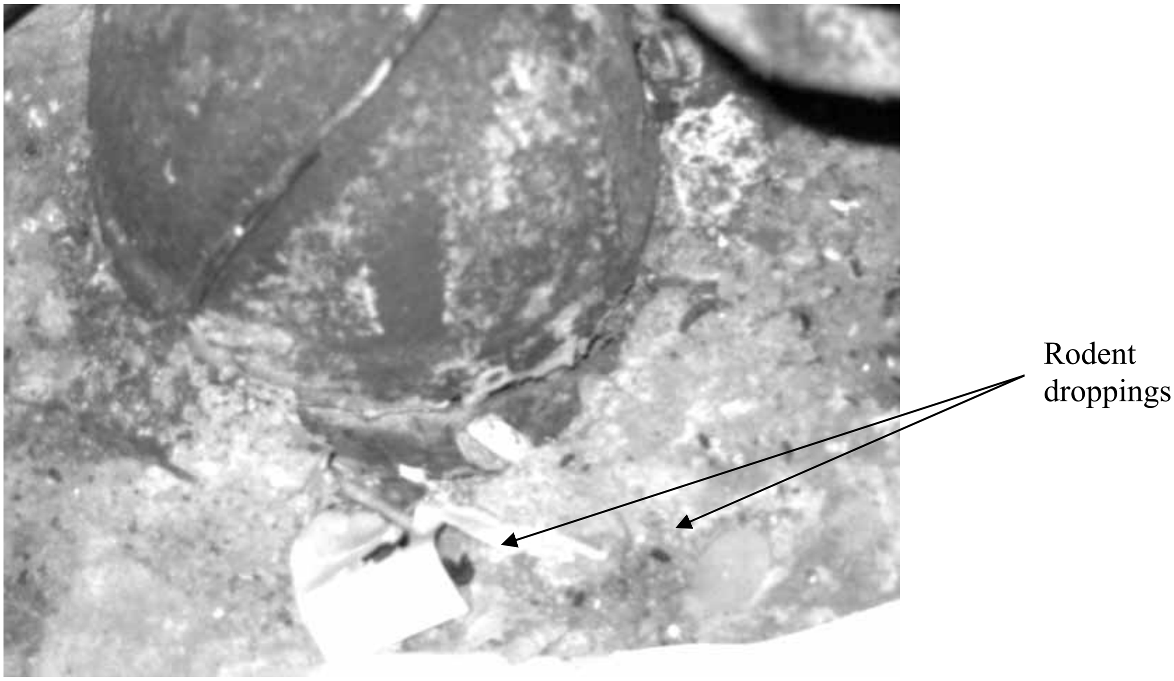
Dust occluded window-mounted air conditioner filter

Picture 17



Poorly sized univent filter that is missing case

Picture 18



Rodent droppings in air-handling cabinet of univent

Picture 19

Breach around pipe in univent air-handling cabinet

Picture 20

Bird nesting material in exhaust

Picture 21

Tennis balls on chair leg

Picture 22

"Glides" on Bottom of Chair Legs

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180 Mountain Avenue, Arlington, MA 02174 **12/14/2004**

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									Supply	Exhaust	
background	ND	29	45	385	ND	ND	18	N # open: 0 # total: 0			Comments: Sunny, NW wind 20-25 mph.
Q	ND	72	30	1136	ND	ND	ND	Y # open: 0 # total: 2	N	N	
gym B	ND	68	25	541	ND	ND	8	Y # open: 0 # total: 7	Y univent dust/debris	Y wall	
L	1	71	24	965	ND	ND	6	Y # open: 1 # total: 2	N	N	Hallway DO, items.
computer room	ND	71	19	607	ND	ND	3	Y # open: 0 # total: 2	Y wall	Y ceiling (off)	Comments: 23 computers.
II	1	71	18	628	ND	ND	2	N # open: 0 # total: 0	Y univent	Y wall items	Hallway DO, AP, Comments: Hamilton Beach Air Purifier with UV.

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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

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180 Mountain Avenue, Arlington, MA 02174 **12/14/2004**

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ELC	ND	71	20	569	ND	ND	2	N # open: 0 # total: 0	Y univent (off)	N	
library	21	69	21	935	ND	ND	5	Y # open: 0 # total: 8	Y univent (off)	Y wall (off)	window-mounted AC,
cafeteria	ND	66	27	673	ND	ND	5	N # open: 0 # total: 0	Y wall	Y wall	Hallway DO, cleaners.
K-3	ND	61	21	680	ND	ND	4	Y # open: 0 # total: 4	Y univent (off) items	Y wall (off)	
K-2	18	60	23	728	ND	ND	6	N # open: 0 # total: 0	Y univent (off)	Y wall	Hallway DO, UF, cleaners, FC re-use, food use/storage, Comments: occupants left approximately 5 minutes prior to assessment.

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180 Mountain Avenue, Arlington, MA 02174 | **12/14/2004**

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									Supply	Exhaust	
K-1	20	62	23	765	ND	ND	7	Y # open: 0 # total: 4	Y univent (off)	Y wall (off)	Hallway DO, UF, Comments: occupants left apprxomiately 5 minutes prior to assessment.
1	8	72	21	924	ND	ND	4	Y # open: 0 # total: 8	Y univent (off)	Y wall (off)	Hallway DO, CD, DEM, cleaners.
2	18	72	27	1269	ND	ND	14	Y # open: 0 # total: 8	Y univent (off)	Y wall (off) boxes furniture	CD, DEM, items.
3	17	71	18	805	ND	ND	4	Y # open: 0 # total: 8	Y univent (off) items	Y wall (off)	CD, aqua/terra, plants.

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M. Norcross Stratton Elementary School

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12/14/2004

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4	17	72	25	1196	ND	ND	14	Y # open: 0 # total: 8	Y univent (off) boxes items furniture	Y wall (off)	Hallway DO, CD, DEM, cleaners.
5	23	72	21	1058	ND	ND	11	Y # open: 0 # total: 8	Y univent items	Y wall (off)	Hallway DO, CD, DEM, items hanging from CT, plants.
6	18	72	25	1182	ND	ND	11	Y # open: 2 # total: 8	Y univent (off) items furniture	Y wall (off) boxes items dust/debris furniture	Hallway DO, CD, DEM, cleaners.
7	20	71	21	1021	ND	ND	5	Y # open: 1 # total: 8	Y univent (off) items	Y wall	Hallway DO, CD, DEM, UF.

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									Supply	Exhaust	
8	22	71	25	1106	ND	ND	13	Y # open: 0 # total: 8	Y univent (off) items	Y wall (off) dust/debris	Hallway DO, AD, CD, DEM, cleaners, plants.
9	1	71	24	1165	ND	ND	9	Y # open: 0 # total: 8	Y univent (off)	Y wall (off) location	Hallway DO, AD, CD, cleaners, Comments: unlabelled bottles.
10	18	71	27	1417	ND	ND	9	Y # open: 1 # total: 8	Y univent	Y wall (off)	CD, PF, TB, UF, cleaners, Comments: slight odor near open window.
11	25	71	24	1112	ND	ND	9	Y # open: 0 # total: 6	Y univent (off) items furniture	Y wall items	Hallway DO, breach sink/counter, CD, DEM, PF, plants.

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									Supply	Exhaust	
12	ND	70	29	1264	ND	ND	9	Y # open: 0 # total: 4	Y univent (off) furniture	Y wall (off)	Hallway DO,
13	ND	68	30	1230	ND	ND	8	Y # open: 0 # total: 8	Y univent (off) furniture	Y wall (off)	Hallway DO, CD, PF, TB, cleaners, Comments: unlabelled bottles.
14	24	67	41	1436	ND	ND	8	Y # open: 0 # total: 8	Y univent (off)	Y wall (off) location	CD, PF.
15	24	74	33	1136	ND	ND	6	Y # open: 3 # total: 8	Y univent	Y wall	breach sink/counter, CD, cleaners, items, Comments: varnish remover.
20	3	72	17	616	ND	ND	3	Y # open: 0 # total: 8	Y univent items	Y wall items	Hallway DO, UF.

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21	21	72	19	838	ND	ND	2	Y # open: 0 # total: 4	Y univent items plant(s)	Y wall (off) items	CD, UF, cleaners, items, plants, Comments: use of childproof locks.
22	15	71	14	690	ND	ND	4	Y # open: 1 # total: 8	Y univent	Y dust/debris	DEM, TB, items hanging from CT.
23	15	70	20	948	ND	ND	8	Y # open: 0 # total: 8	Y univent items	Y wall	CD, UF, cleaners, items, pets, plants.
24	22	74	23	1310	ND	ND	11	Y # open: 0 # total: 8	Y univent (off) furniture	Y wall (off) (BD) dust/debris	Hallway DO, items, FC re-use.
25	23	71	91	789	ND	ND	7	Y # open: 0 # total: 4	Y univent items plant(s)	Y wall location	Hallway DO, DEM, PF, TB, cleaners, items, plants.

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									Supply	Exhaust	
26	23	72	26	1303	ND	ND	7	Y # open: 0 # total: 8	Y univent (off) items furniture	Y wall (off)	Hallway DO, CD, items, Comments: use of childproof locks.
27	15	26	68	1093	ND	ND	8	Y # open: 0 # total: 6	Y univent (off)	Y wall (off)	Hallway DO, breach sink/counter, cleaners, items, plants.
28	ND	72	24	856	ND	ND	7	Y # open: 0 # total: 3	Y univent	Y wall location dust/debris	CD, PS, cleaners; CT: low moisture
29	ND	69	24	923	ND	ND	7	Y # open: 0 # total: 6	Y univent items furniture plant(s)	Y wall (off)	Hallway DO, CD, DEM, TB, cleaners, plants; sink cupboard base: low moisture

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30	2	72	24	1105	ND	ND	10	Y # open: 0 # total: 6	Y univent	Y wall (off)	Hallway DO, breach sink/counter, CD, PF, cleaners, items; sink cupboard base: low moisture

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